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Research paper citation record keeping: It is not for wimps

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ABSTRACT: In an era in which academic institutions are held more accountable, a problem, which does not seem to have an immediate resolution, exists: how does one demonstrate the quality of one's work? Specifically, how does one show that his or her research is making an impact and is thought to be important? A variety of measures of scientific journal article impor-

tance, reflected mostly by citation analyses, have been focused on as being potential gold standards. However, although several measures have been reported, keeping a record of citation of individual research papers, primarily due to the effort involved in finding accurate information, is not for wimps.

Key words: citation analysis, citation tracker, Hirsch index

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The professional career of a scientist is much different today compared with even 20 yr ago. Then, everyone in the department celebrated when a member of the faculty published a manuscript; the department placed a notice about it in the weekly departmental newsletter, the author passed around reprints for others to see, and the college even placed a manuscript number on each publication to account for the total publications by the college in any given year. At a time before computers (Dodson, 2007), the scientist gave signed copies of the final paper to secretaries, because they had spent considerable effort in typing drafts, compiling submittal copies of the manuscript, and filing away all ancillary material related to completion of the scientific paper. Things are different today. Presently, the focus is on how much grant support any particular individual possesses at any given time (Dodson, 1995, 2006a), the goal being maximum generation of overhead, and few (if any) administrator(s) read any scientific manuscript from faculty members (Dodson, 2006b).

However, faculty members are more accountable than in previous years and will be assessed in the future on the impact of their research to the scientific community. How are they held accountable for their science—especially if their immediate administrators or colleagues do not read their scientific papers? Perhaps the most accepted of the recent evaluation-assessment measures is the Hirsch index (**h-index**; Hirsch, 2005), whereby one sums the absolute number of the papers

with greater than or equal to the most citations. For simplicity, if one has 17 papers with at least 17 citations, then the h-index = 17. Relevance of the h-index to research output over time has also been proposed, suggesting that the h-index should rise by (at least) 1 paper for each year that one actively pursues scientific research (Hirsch, 2005). What this implies is that if one has worked in an academic position for 20 yrs, then the h-index should be at least 20 to demonstrate impact and productivity (Hirsch, 2005). The h-index seems to be gaining strength within the academic community, even though some detractors remain and other citation indexes have been proposed. Moreover, the h-index may have predictive function to suggest potential of individuals (Hirsch, 2007).

The point of this paper is to inform the reader about the time and process it may take a nonsuperstar faculty member to obtain an accurate citation number for use in calculating the h-index. For those individuals who publish papers that receive huge numbers of citations, a somewhat accurate count of paper citations is possible. However, what is involved in obtaining the data for the generation of an accurate h-index for the average scientist or a scientist in a field such as agriculture, who may publish regularly in more topic-specific journals?

To retrieve article citation data, one needs to search with a variety of citation-tracking services. Many of these are free to researchers at academic institutions that subscribe to online access for employees. Search motors like ISI Web of Knowledge or Scopus are commonly used to obtain citation status of scientific articles (Fingerman, 2006). Moreover, Google Scholar (Beta) can be accessed, although it is somewhat gen-

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eral, and the resultant data should be validated (Burright, 2006). Numerous other citation-tracking motors exist; however, results might not be consistent and citation numbers may vary considerably. This presents some potential problems when finding citations to specific papers, and searches on more than 1 motor may be needed to obtain an accurate sampling of citations.

Over the past few months, and out of curiosity, I conducted a citation analysis of my publications. Although the process was unacceptable (at best) and considerable time was spent comparing data derived from different citation-tracking motors, the end result was enlightening. Including only papers published and not those submitted or in press, I have 85 scientific papers. Four of these were in new journals not in any citation-tracking motor. My papers received 1,001 citations for the complete body of work generated from the following paper-type citations: 690 (data), 193 (review), 82 (perspective), 26 (methods), and 10 (clinical). My highest-cited paper had 120 citations. After ordering the papers according to citation number from highest to lowest, my h-index was 17, with an additional 10 papers close ($\geq 10 \leq 17$ citations). Numerous papers may obtain requisite citations and increase the h-index in the immediate future.

What does this compilation of citations critically tell me, as someone who has always considered himself to be a productive, but a normal, scientist? First, papers receiving attention for calculating the h-index were a balance of data, review, and methods papers. Because I enjoy servicing different audiences, this was especially surprising to me, but somewhat pleasant. Second, although one might think that certain papers will receive large numbers of citations and others will not, it was surprising to actually see the papers that were highly cited and those that did not receive many citations at all. Third, perhaps I have some work to do to make my h-index parallel the total number of years that I have been in science. Because my h-index is lower than my actual number of years (23) as a scientist, a case could be made for me not writing impactful papers. Of course, I could rebut those arguments for many reasons, because I publish papers to target specific groups in agriculture (Dodson, 2008). However, the plain result suggests that I might consider how and to what journal I submit my scientific results. Fourth, it will be some time before I again submit to compiling data of this nature. Comparing data from different citation-tracking motors (for 85 publications going

back to 1982) was tedious, and there is too much room for one to fudge and declare wrong citation figures. To this end, I propose that an agency such as the National Science Foundation coalesce all citation-tracking motors under 1 umbrella so that consistent data may be obtained in a short timeframe. Finally, what am I to do with the upkeep of the data that I have obtained? How am I going to use it or maintain records?

So, it comes down to time. In today's push toward (impactful) productivity and accountability, which "worker bee" faculty member is going to spend the time required to obtain citation numbers? Moreover, if one has a large publication record that spans decades, how much time will it take to search multiple citation-tracking motors to obtain an accurate reflection of citations? If one does not search in multiple citation motors, it is likely that citation numbers will be underestimated and that a decreased h-index will result. Moreover, to upkeep one's h-index (over time), one will be required to list in order all publications (highest to lowest) and periodically search the citation-tracking motors to determine if new citations to specific papers occurred. Many faculty members will never spend their time conducting citation searches on their publications. Indeed, considerable effort over the course of some duration is required to obtain an accurate database of citations for computing any citation measure. For sure, research paper citation record keeping is not for wimps.

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